L Number	Hits	Search Text	DB	Time stamp
-	262	(rout$6 with (parameter or QoS or characteristic)) and PPP and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 07:33
-	8	((multiple with PPP) same ((single or "same") near3 address)) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 08:45
-	58	(((PPP or (point near2 point)) with (connection or link or session or channel) with (multiple or multi or many or plurality)) same (address with (single or "same" or one))) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 08:58
-	117	(((PPP or (point near2 point)) with (connection or link or session or channel) with (multiple or multi or many or plurality)) same (address with (single or "same" or one)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 09:05
-	91	(((connection or link or session or channel) near3 (multiple or multi or many or plurality)) with (address near3 (single or "same" or one))).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 09:10
-	183	(((connection or link or session or channel) near3 (multiple or multi or many or plurality)) with (address near3 (single or "same" or one))) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 09:27
-	25	(PPP same address same QoS) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 09:28
-	9	("5557798" | "5717689" | "5757783" | "5822309" | "6049549" | "6222820" | "6223222" | "6286052" | "6330316").PN.	USPAT	2004/09/20 09:34
-	17	("5311513" | "5497371" | "5684791" | "5745380" | "5771459" | "5787080" | "5956341" | "5970062" | "6011776" | "6023456" | "6026082" | "6084888" | "6157614" | "6188670" | "6412006" | "6477141" | "6487212").PN.	USPAT	2004/09/20 09:43
-	7	("5822319" | "5987022" | "6189033" | "6253326" | "6295532" | "6415313" | "6466985").PN.	USPAT	2004/09/20 09:57

-	29	PPP and CDMA and PDSN and IPCP and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 12:27
-	53	PPP and CDMA and PDSN and (compression or encrypt$6) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 12:37
-	104	PPP and CDMA and (encrypt$6) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 15:34
-	57	(PPP same encrypt$6) and 370/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/20 15:34
-	94	IPCP and (configuration with option)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 07:34

Network Working Group   G. McGregor
Request for Comments: 1332   Merit
Obsoletes: RFC 1172   May 1992

             The PPP Internet Protocol Control Protocol (IPCP)

Status of this Memo

   This RFC specifies an IAB standards track protocol for the Internet
   community, and requests discussion and suggestions for improvements.
   Please refer to the current edition of the "IAB Official Protocol
   Standards" for the standardization state and status of this protocol.
   Distribution of this memo is unlimited.

Abstract

   The Point-to-Point Protocol (PPP) [1] provides a standard method of
   encapsulating Network Layer protocol information over point-to-point
   links. PPP also defines an extensible Link Control Protocol, and
   proposes a family of Network Control Protocols (NCPs) for
   establishing and configuring different network-layer protocols.

   This document defines the NCP for establishing and configuring the
   Internet Protocol [2] over PPP, and a method to negotiate and use Van
   Jacobson TCP/IP header compression [3] with PPP.

   This RFC is a product of the Point-to-Point Protocol Working Group of
   the Internet Engineering Task Force (IETF).

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Table of Contents

1. Introduction

    PPP has three main components:

1. A method for encapsulating datagrams over serial links.

2. A Link Control Protocol (LCP) for establishing, configuring, and testing the data-link connection.

3. A family of Network Control Protocols (NCPs) for establishing and configuring different network-layer protocols.

In order to establish communications over a point-to-point link, each end of the PPP link must first send LCP packets to configure and test the data link. After the link has been established and optional facilities have been negotiated as needed by the LCP, PPP must send NCP packets to choose and configure one or more network-layer protocols. Once each of the chosen network-layer protocols has been configured, datagrams from each network-layer protocol can be sent over the link.

The link will remain configured for communications until explicit LCP or NCP packets close the link down, or until some external event occurs (an inactivity timer expires or network administrator intervention).

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2. A PPP Network Control Protocol (NCP) for IP

The IP Control Protocol (IPCP) is responsible for configuring, enabling, and disabling the IP protocol modules on both ends of the point-to-point link. IPCP uses the same packet exchange mechanism as the Link Control Protocol (LCP). IPCP packets may not be exchanged until PPP has reached the Network-Layer Protocol phase. IPCP packets received before this phase is reached should be silently discarded.

The IP Control Protocol is exactly the same as the Link Control
Protocol [1] with the following exceptions:

Data Link Layer Protocol Field

   Exactly one IPCP packet is encapsulated in the Information field
   of PPP Data Link Layer frames where the Protocol field indicates
   type hex 8021 (IP Control Protocol).

Code field

   Only Codes 1 through 7 (Configure-Request, Configure-Ack,
   Configure-Nak, Configure-Reject, Terminate-Request, Terminate-Ack
   and Code-Reject) are used. Other Codes should be treated as
   unrecognized and should result in Code-Rejects.

Timeouts

   IPCP packets may not be exchanged until PPP has reached the
   Network-Layer Protocol phase. An implementation should be
   prepared to wait for Authentication and Link Quality Determination
   to finish before timing out waiting for a Configure-Ack or other
   response. It is suggested that an implementation give up only
   after user intervention or a configurable amount of time.

Configuration Option Types

   IPCP has a distinct set of Configuration Options, which are
   defined below.

2.1. Sending IP Datagrams

   Before any IP packets may be communicated, PPP must reach the
   Network-Layer Protocol phase, and the IP Control Protocol must reach
   the Opened state.

   Exactly one IP packet is encapsulated in the Information field of PPP
   Data Link Layer frames where the Protocol field indicates type hex
   0021 (Internet Protocol).

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   The maximum length of an IP packet transmitted over a PPP link is the
   same as the maximum length of the Information field of a PPP data
   link layer frame. Larger IP datagrams must be fragmented as
   necessary. If a system wishes to avoid fragmentation and reassembly,
   it should use the TCP Maximum Segment Size option [4], and MTU
   discovery [5].

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3. IPCP Configuration Options

IPCP Configuration Options allow negotiatiation of desirable Internet
Protocol parameters. IPCP uses the same Configuration Option format
defined for LCP [1], with a separate set of Options.

The most up-to-date values of the IPCP Option Type field are specified
in the most recent "Assigned Numbers" RFC [6]. Current values are
assigned as follows:

        1   IP-Addresses
        2   IP-Compression-Protocol
        3   IP-Address

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3.1.   IP-Addresses

   Description

      The use of the Configuration Option IP-Addresses has been
      deprecated. It has been determined through implementation
      experience that it is difficult to ensure negotiation convergence
      in all cases using this option. RFC 1172 [7] provides information
      for implementations requiring backwards compatability. The IP-
      Address Configuration Option replaces this option, and its use is
      preferred.

      This option SHOULD NOT be sent in a Configure-Request if a
      Configure-Request has been received which includes either an IP-
      Addresses or IP-Address option. This option MAY be sent if a
      Configure-Reject is received for the IP-Address option, or a
      Configure-Nak is received with an IP-Addresses option as an
      appended option.

      Support for this option MAY be removed after the IPCP protocol

status advances to Internet Draft Standard.

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3.2. IP-Compression-Protocol

   Description

      This Configuration Option provides a way to negotiate the use of a
      specific compression protocol. By default, compression is not
      enabled.

   A summary of the IP-Compression-Protocol Configuration Option format
   is shown below. The fields are transmitted from left to right.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     |    IP-Compression-Protocol    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Data ...
+-+-+-+-+-+
```

   Type

      2

   Length

```
        >= 4

   IP-Compression-Protocol

        The IP-Compression-Protocol field is two octets and indicates the
        compression protocol desired.  Values for this field are always
        the same as the PPP Data Link Layer Protocol field values for that
        same compression protocol.

        The most up-to-date values of the IP-Compression-Protocol field
        are specified in the most recent "Assigned Numbers" RFC [6].
        Current values are assigned as follows:

           Value (in hex)          Protocol

           002d                    Van Jacobson Compressed TCP/IP

   Data

        The Data field is zero or more octets and contains additional data
        as determined by the particular compression protocol.
```

```
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```

```
   Default

        No compression protocol enabled.
```

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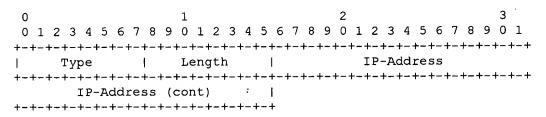3.3. IP-Address

   Description

      This Configuration Option provides a way to negotiate the IP
      address to be used on the local end of the link. It allows the
      sender of the Configure-Request to state which IP-address is
      desired, or to request that the peer provide the information. The
      peer can provide this information by NAKing the option, and
      returning a valid IP-address.

      If negotiation about the remote IP-address is required, and the
      peer did not provide the option in its Configure-Request, the
      option SHOULD be appended to a Configure-Nak. The value of the
      IP-address given must be acceptable as the remote IP-address, or
      indicate a request that the peer provide the information.

      By default, no IP address is assigned.

   A summary of the IP-Address Configuration Option format is shown
   below. The fields are transmitted from left to right.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     |          IP-Address
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
        IP-Address (cont)       : |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Type

   3

Length

   6

IP-Address

   The four octet IP-Address is the desired local address of the
   sender of a Configure-Request. If all four octets are set to
   zero, it indicates a request that the peer provide the IP-Address
   information.

Default

   No IP address is assigned.

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4. Van Jacobson TCP/IP header compression

Van Jacobson TCP/IP header compression reduces the size of the TCP/IP
headers to as few as three bytes. This can be a significant improvement
on slow serial lines, particularly for interactive traffic.

The IP-Compression-Protocol Configuration Option is used to indicate the
ability to receive compressed packets. Each end of the link must
separately request this option if bi-directional compression is desired.

The PPP Protocol field is set to the following values when transmitting
IP packets:

   Value (in hex)

   0021   Type IP. The IP protocol is not TCP, or the packet is a
             fragment, or cannot be compressed.

   002d   Compressed TCP. The TCP/IP headers are replaced by the
             compressed header.

   002f   Uncompressed TCP. The IP protocol field is replaced by
             the slot identifier.

4.1. Configuration Option Format

   A summary of the IP-Compression-Protocol Configuration Option format
   to negotiate Van Jacobson TCP/IP header compression is shown below.
   The fields are transmitted from left to right.

    0   1   2   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+
   | Type | Length | IP-Compression-Protocol |
   +-+
   | Max-Slot-Id | Comp-Slot-Id |

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type

   2

Length

   6

   IP-Compression-Protocol

      002d (hex) for Van Jacobson Compressed TCP/IP headers.

   Max-Slot-Id

      The Max-Slot-Id field is one octet and indicates the maximum slot
      identifier. This is one less than the actual number of slots; the
      slot identifier has values from zero to Max-Slot-Id.

         Note: There may be implementations that have problems with only
         one slot (Max-Slot-Id = 0). See the discussion in reference
         [3]. The example implementation in [3] will only work with 3
         through 254 slots.

   Comp-Slot-Id

      The Comp-Slot-Id field is one octet and indicates whether the slot
      identifier field may be compressed.

         0 The slot identifier must not be compressed. All compressed
            TCP packets must set the C bit in every change mask, and
            must include the slot identifier.

         1 The slot identifer may be compressed.

      The slot identifier must not be compressed if there is no ability
      for the PPP link level to indicate an error in reception to the
      decompression module. Synchronization after errors depends on
      receiving a packet with the slot identifier. See the discussion
      in reference [3].

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A. IPCP Recommended Options

    The following Configurations Options are recommended:

        IP-Compression-Protocol -- with at least 4 slots, usually 16
        slots.

        IP-Address -- only on dial-up lines.

Security Considerations

    Security issues are not discussed in this memo.

References

    [1]   Simpson, W., "The Point-to-Point Protocol", RFC 1331, May 1992.

    [2]   Postel, J., "Internet Protocol", RFC 791, USC/Information
            Sciences Institute, September 1981.

    [3]   Jacobson, V., "Compressing TCP/IP Headers", RFC 1144, January
            1990.

    [4]   Postel, J., "The TCP Maximum Segment Size Option and Related
            Topics", RFC 879, USC/Information Sciences Institute, November
            1983.

    [5]   Mogul, J., and S. Deering, "Path MTU Discovery", RFC 1191,
            November 1990.

    [6]   Reynolds, J., and J. Postel, "Assigned Numbers", RFC 1060,
            USC/Information Sciences Institute, March 1990.

    [7]   Perkins, D., and R. Hobby, "Point-to-Point Protocol (PPP)
            initial configuration options", RFC 1172, August 1990.

Information leading to the expanded IP-Compression option provided by
Van Jacobson at SIGCOMM '90.

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    Bill Simpson helped with the document formatting.

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